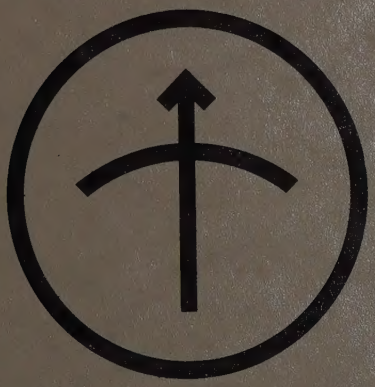
MODEL 202-C
STANDARD BOLOMETER BRIDGE

Operating INSTRUCTIONS



MEASUREMENTS

A McGRAW-EDISON DIVISION

BOONTON NEW JERSEY

MODEL 202-C
STANDARD BOLOMETER BRIDGE

Operating INSTRUCTIONS

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BOONTON NEW JERSEY

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Additional information with regard to the applications and maintenance of this equipment will be available from time to time. Users of the Model 202-C are urged to discuss their problems with us and to suggest such modifications as might make the instrument more adaptable to their special requirements.

Maintenance difficulties should be reported to Measurements Corporation before proceeding with actual repairs, since, through our familiarity with the instrument, we are able to suggest the appropriate repair procedure.

Engineering Department

MEASUREMENTS CORPORATION

Boonton, New Jersey

U. S. A.

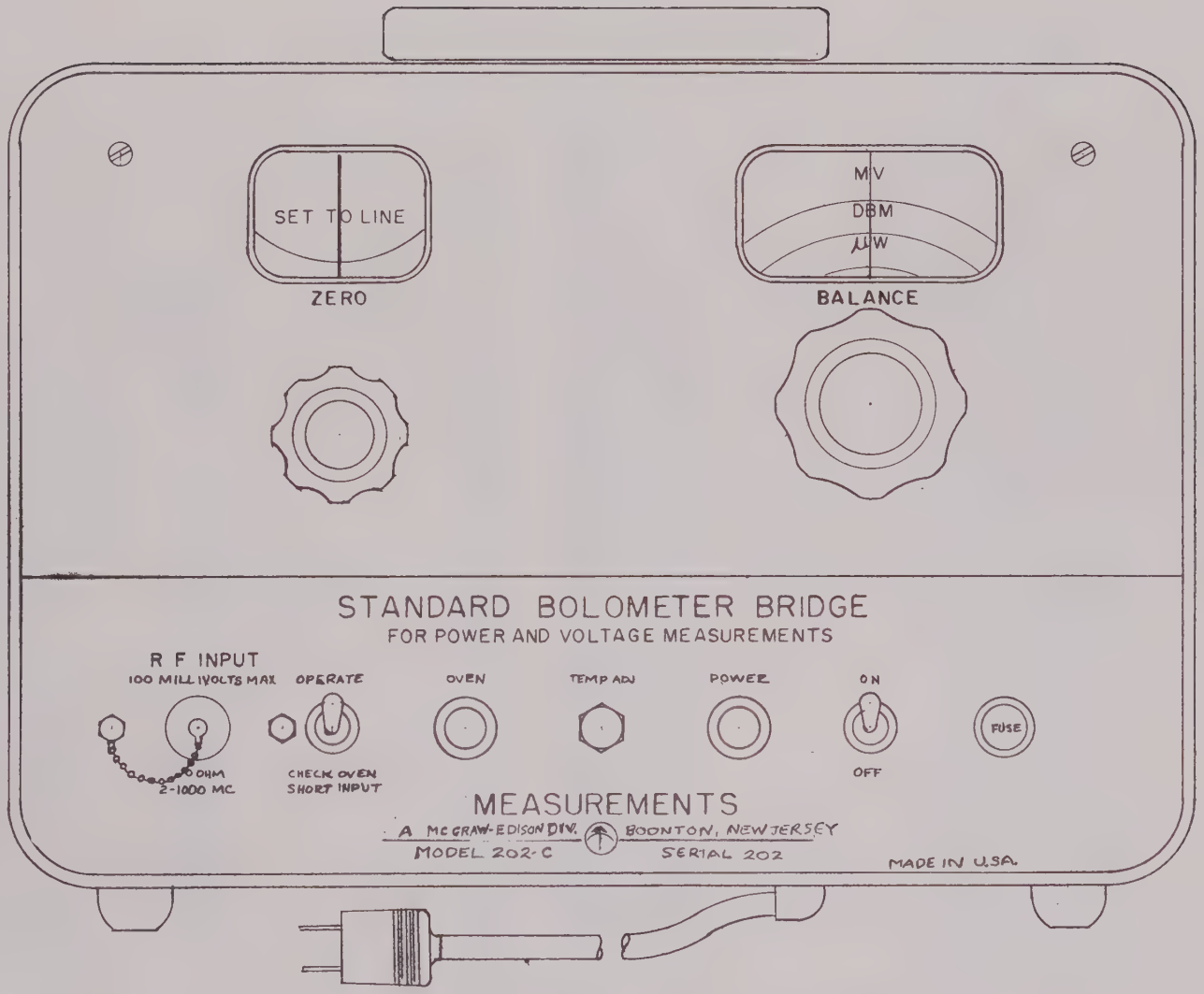


Figure 1. Front View of Model 202-C Standard Bolometer Bridge.

CHAPTER 1

INTRODUCTION

SECTION I

GENERAL

1. SCOPE OF MANUAL

a. This manual describes the basic operation, construction and maintenance of the Model 202-C Standard Bolometer Bridge. Following the text of the manual are two appendices. Appendix I describes the recommended procedure for preparing the instrument for prolonged storage or re-shipment. Appendix II contains an Identification Table of Replaceable Parts, listing reference symbols, name, description and drawing number of each part required for maintenance.

SECTION II

DESCRIPTION AND DATA

2. GENERAL

a. The Model 202-C Standard Bolometer Bridge is a portable instrument for the precise measurement of radio frequency power, voltage or power and voltage ratios. When operated in accordance with the instructions given below, it provides the most accurate standardization of high-frequency signals available at the present time.

b. The purchaser is invited to correspond with Measurements Corporation concerning any special modifications or applications of the Model 202-C.

3. TECHNICAL CHARACTERISTICS

a. Range:

(1) Voltage: 20 to 70 millivolts RMS.

(2) Power: 10 to 100 microwatts. (20 millivolts is equivalent to 8 microwatts, the minimum reading).

(3) DBM: From -10 to -21 DBM.

b. Frequency Range: 2 Mc to 1000 Mc. (No tuning or frequency corrections necessary).

c. Input Impedance: 50 ohms, VSWR less than 1.2 at 1000 Mc.

d. Accuracy:

(1) ± 5% from 2 Mc to 400 Mc.

(2) ± 10% from 400 Mc to 1000 Mc.

e. Power Source: 117-volt, 50-60 cycle A.C.

f. Power Consumption: 45 watts.

g. Fuse Protection: One, 1/2 ampere slow blow.

4. COMPONENTS SUPPLIED

a. See Table I. Table of Components.

TABLE I. TABLE OF COMPONENTS

Quan.	Description	Case Dimensions			Unit Weight	Volume Cu. Ft.
		Height	Width	Depth		
1	Model 202-C Standard Bolometer Bridge.	10"	14"	7-1/4"	18-3/4 Lbs.	0.6
1	Manual of Operating Instructions.					
2	Tubes, RETMA #12AX7, installed.					
1	Tube, RETMA #12AU7, installed.					
1	Tube, RETMA #2D21, installed.					
1	Tube, RETMA #6X4, installed.					
3	Lamps, Mazda #44, installed.					
1	Lamp, NE51, installed.					

5. EXPORT PACKAGING

a. Packed for export, the Model 202-C is packed in a wooden box.

TABLE II. EXPORT PACKAGING DATA

Number of Packages	Case Dimensions			Weight	Volume Cu. Ft.
	Height	Width	Depth		
1	17"	22"	17"	60#	3.7

CHAPTER 2

OPERATING INSTRUCTIONS

SECTION I

SERVICE UPON RECEIPT OF EQUIPMENT

6. UNPACKING

a. Take care when unpacking or handling the equipment. Follow the procedure outlined below when unpacking the instrument.

(1) Place the packing case in a location where it can be easily opened.

(2) Remove nails with a nail puller and remove the top of the packing case. If the instrument is packed in a carton, slit the carton carefully.

(3) Lift the instrument from the packing case and remove the paper wrapping.

(4) Inspect the case and controls on the front panel for possible damage during shipment.

7. PRELIMINARY PRECAUTIONS

a. Warning! Permanent damage to this instrument may result if more than 1/2 volt, either a.c. or d.c. is applied to the input fitting. When connecting the Model 202-C to signal generators, make certain that no surges can occur and that no d.c. or a.c. component is present at the point of connection.

b. Connect the Model 202-C only to a source of power for which it is rated.

SECTION II

CONTROLS AND INSTRUMENTS

8. R.F. INPUT

a. This is a coaxial type N fitting located in the lower left corner of the main panel.

9. OPERATE/CHECK OVEN Switch

a. This is the toggle switch located just to the right of the R.F. INPUT fitting.

10. OVEN Indicator Lamp

a. This is a small neon NE51 indicator lamp located just to the right of the OPERATE/CHECK OVEN switch, and serves to indicate when the oven heater is activated.

11. TEMP. ADJ. Control

a. Located just to the right of the OVEN indicator lamp, the TEMP. ADJ. control adjusts the temperature of the oven to a temperature determined at the factory.

12. POWER Indicator Lamp

a. This jeweled pilot lamp indicates when power is applied to the instrument.

13. ON/OFF Switch

a. This switch located just to the right of the pilot lamp controls line power to the instrument.

14. FUSE

a. The 1/2 amp slow blow FUSE is connected in series with the line switch and power cord. It is located in the extreme lower right corner of the front panel and serves to protect the instrument from overloads.

15. ZERO Control

a. Located just below the galvanometer window opening, this dual resistor control serves to compensate the Model 202-C bridge circuit for various values of generator or signal source impedance.

16. BALANCE Control

a. The BALANCE control is a calibrated precision rheostat which is manually adjusted to rebalance the barretter bridge when it is unbalanced by the r-f input signal. It is calibrated in millivolts, DBM, and microwatts.

SECTION III

OPERATION

17. INSTALLATION AND ADJUSTMENT

a. The Model 202-C is a delicate and accurate measuring device. It should be handled as carefully as a precision meter.

18. CONNECTION FOR OPERATION

a. The line plug should be connected to a 117-volt 50-60 cycle source of power. If power source is other than specified, the manufacturer should be consulted.

19. PRELIMINARY OPERATIONAL CHECKS

a. Throw the power switch to ON; the pilot lamp will light, and after a few seconds the clear neon OVEN pilot lamp should light steadily, indicating that the oven is warming up.

20. PRE-SETUP PROCEDURE

a. While the oven of the Bolometer Bridge is warming up (about fifteen minutes), select the equipment to meet the following requirements:

(1) Choose a coaxial cable having a nominal characteristic impedance of 50 ohms terminated in a Type N connector.

(2) Be sure that the signal source to be measured contains no spurious d.c., or low-frequency a-c components.

(3) The level of the r-f voltage must lie between 20 and 70 millivolts (.02 to .07 r.m.s. volts). For the measurement of higher voltages, use accurate fixed attenuator pads.

(4) CAUTION: KEEP THE VOLTAGE APPLIED TO THE R.F. INPUT UNDER 0.5 VOLT A.C. OR D.C. WHEN CONNECTING THE MODEL 202-C TO SIGNAL GENERATORS, MAKE CERTAIN THAT NO SURGES CAN OCCUR AND THAT NO SPURIOUS D-C OR A-C COMPONENT IS PRESENT AT THE POINT OF CONNECTION.

21. PRELIMINARY OVEN CHECK

a. After the OVEN neon pilot lamp starts to flash on and off for approximately equal periods, throw the OPERATE/CHECK OVEN switch to the CHECK OVEN position.

b. Short the R.F. INPUT panel connector with the special shorting cap provided.

c. If the oven temperature is correctly adjusted, the ZERO meter pointer should indicate exactly on the center reference line.

d. If the meter pointer does not indicate on the reference line after allowing several minutes for warm-up, adjust the oven temperature to the correct value as follows:

(1) Remove the protective cap on the TEMP. ADJ. control.

(2) Set the meter pointer to the reference line by turning the slotted shaft in small increments, giving the oven temperature a chance to stabilize between each adjustment.

(3) Turning the shaft clockwise will raise the oven temperature, and will cause the meter pointer to move to the right. Turning the shaft counterclockwise will do the inverse.

(4) Ignore slight deflections of the meter pointer which may occur as the oven heating circuit switches on and off.

22. OPERATING INSTRUCTIONS

CAUTION:

DO NOT EXCEED 0.5 VOLT INPUT. A VOLTAGE EXCEEDING THIS VALUE MAY BURN OUT, OR DAMAGE THE SENSITIVE BOLOMETER ELEMENT. IT IS GOOD PRACTICE NOT TO EXCEED 0.1 VOLT INPUT.

a. Remove the shorting cap and connect the R.F. INPUT fitting to the source to be measured.

b. Throw the OPERATE/CHECK OVEN switch to OPERATE.

c. To compensate for the internal source impedance of the signal source being measured:

(1) Set the BALANCE dial to the line marked ZERO near the counterclockwise position.

(2) Reduce the carrier of the signal source to a minimum output level of less than 100 microvolts.

(3) Set the meter to the reference LINE by turning the ZERO knob.

d. Increase the input signal amplitude to the measuring level of 20 to 70 millivolts. The meter pointer should swing to the right.

e. Rotate the BALANCE knob to set the meter to the reference LINE.

f. Read the corresponding input signal level in MILLIVOLTS, MICROWATTS or DBM in 50 ohms on the BALANCE dial.

g. It is recommended that a good-quality 6-db (2:1 voltage ratio) 50-ohm pad such as MEASUREMENTS CORPORATION Type 80-ZH3 be connected to the output of the signal generator if the source impedance is not 50-ohms with a low VSWR. A 100-millivolt output from the signal generator will then read 50 millivolts on the Model 202-C. The 50-millivolt point on the Model 202-C is the balance point having the best accuracy.

NOTE:

To avoid errors in measurement of carrier level, there should be no amplitude modulation of the source being measured as the Model 202-C is a true r.m.s. measuring device and will indicate a rise in level by the amount of the modulation side-band power. Also any direct-current, 60-cycle, or other low-frequency spurious components in the signal source can cause erroneous readings. For this reason strong magnetic fields at line frequency should be avoided.

CHAPTER 3

MAINTENANCE INSTRUCTIONS

SECTION I

MAINTENANCE

23. GENERAL

a. Preventive maintenance procedure is not recommended for the Model 202-C. Preventive maintenance is a series of operations including inspection, adjustment, lubrication, etc., recommended periodically for certain types of equipment to eliminate the possibility of unexpected interruptions in service.

Critical adjustments may be disturbed by too frequent inspection by personnel unfamiliar with the design of the Model 202-C, causing errors in data that would be much more serious than an occasional operational failure.

b. If failure occurs, the instrument should be checked by the procedure outlined in Section III, paragraph 18 through 21, and if trouble other than a defective tube is indicated, the instrument should be returned to Measurements Corporation.

c. For analyzing troubles, see Table III and Table IV.

d. To remove the case from the Model 202-C, refer to paragraph 36.

TABLE III. TROUBLE SHOOTING CHART

TROUBLE	POSSIBLE CAUSE	REMEDY
Pilot lamp does not light.	Defective power plug, receptacle or cord.	Check for poor connection or continuity. Replace, if necessary.
	Defective fuse, F1.	Replace and/or check holder.
	Defective switch S2.	Replace switch.
	Defective lamp E2.	Replace lamp and/or check holder.
	Defective power transformer T3.	Replace T3.
Meter shows no indication.	Tube V5 defective.	Replace V5.
	Tube V1 defective.	Replace V1.
	Tube V2 defective.	Replace V2.
	Transformer T2 defective.	Replace T2.
Meter reads high.	OPERATE/CHECK OVEN switch in wrong position.	Set switch to OPERATE.
	D.C. or low frequency component in signal source.	Remove connecting cable and short input to check for balance.
	Tube V1 developing hum.	Replace V1.
	Instrument has been overloaded.	Check calibration. Para. 24.

TABLE III. TROUBLE SHOOTING CHART

TROUBLE	POSSIBLE CAUSE	REMEDY
Meter reads low.	Oven not up to temperature.	Check if OVEN indicator is cycling approximately every 30 seconds. If not, see below.
	Tube V1 developing hum.	Replace V1.
	Zero Adj. R11 - R12 not properly set.	Paragraphs 18 through 21.
OVEN indicator not cycling.	Indicator lamp E1 defective.	Replace with NE51 neon lamp.
	Tube V4 defective.	Replace V4.
	Tube V3 defective.	Replace V3.
	Rectifier CR1 defective.	Replace CR1.

TABLE IV.

PRELIMINARY TUBE VOLTAGE CHART

TUBE		PLATE		SCREEN (or other grids)		GRID		CATHODE	
No.	Type	Pin	Volts	Pin	Volts	Pin	Volts	Pin	Volts
V1	12AX7	1 6	+80 +120	- -	- -	2 7	0 0	3 8	+0.8 0
V2	12AU7	1 6	-0.3 -0.3	- -	- -	2 7	-4 -4	3 8	3.2 AC 3.2 AC
V3	12AX7	1 6	+200 +170	- -	- -	2 7	0 0	3 8	+1.3 +9
V4	2D21	6	Conducting -100 DC	5	0	1	-2	2	0
V5	6X4	1 & 6	300 AC	-	-	-	-	7	+380

NOTE: D.C. measurements made using 20,000 ohms-per-volt meter.

A.C. measurements made using 1000-ohms-per-volt meter.
Instrument in normally operating CHECK OVEN condition.
± 20% departure from these values may be normal.
All voltages are measured with reference to the chassis ground.

24. CALIBRATION CHECK

a. To check calibration, the following equipment is required:

(1) Accurate 1-ohm resistor.

(2) 1.5 to 2.0 volt battery.

(3) Accurate milliammeter reading 40 to 150 Ma DC.

(4) Rheostat or decade box having at least 50-ohm resistance.

(5) Switch, single pole double throw.

b. With the connection shown in Figure 2, throw the switch to the OFF position. Check oven temperature and zero as outlined in paragraph 21.

c. Throw the switch to ON position, and set the milliammeter to read a current equal to the desired calibration point multiplied by the d.c. calibration factor given on the schematic diagram. For example, if the calibration factor is 2.05 and the 50 millivolt point is to be checked, the milliammeter should be set to read 50 X 2.05, or 102.5 milliamperes.

d. Assuming negligible error in the 1.00 ohm resistor and milliammeter, the bridge should then balance with the dial set to 50 millivolts $\pm$ 2%. Errors appreciably in excess of 2% would indicate a change in the bridge or bolometer characteristics, in which case the instrument should be returned to the manufacturer for servicing.

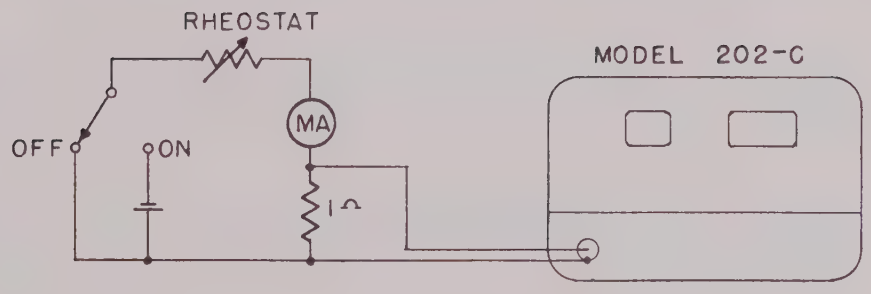


Figure 2. Calibration Check Circuit.

CHAPTER 4

EQUIPMENT USED IN CONJUNCTION WITH MODEL 202-C

SECTION I

GENERAL

25. RECOMMENDED ACCESSORIES

a. No special accessories are required; however, when operating at frequencies above 50 megacycles, it is extremely important to use cables designed for 50-ohm impedance and to use matched 50 ohm fittings.

b. Measurements Corporation manufactures suitable interconnecting cables and attenuating pads for use with the Model 202-C that have been checked for impedance matching and low VSWR.

c. Measurements Corporation Part No. 80-ZH3, a 2:1 voltage ratio pad, (6 db) input and output impedance 50 ohms, equipped with a male type-N connector at the input, and a female type-N connector at the output.

d. Measurements Corporation Part No. M-342, a 10:1 voltage ratio pad (20 db), input and output impedance 50 ohms, equipped with a male type-N connector at the input and a female type-N connector at the output.

e. Measurements Corporation Part No. 84-Z2-3, a 4 ft. coaxial cable (RG-8/U) equipped at both ends with male type-N connectors.

CHAPTER 5

TECHNICAL SERVICE - MAINTENANCE INSTRUCTIONS

SECTION I

GENERAL

26. SCOPE

a. The purpose of this chapter is to acquaint operating and maintenance personnel with the theory of operation of the various circuits in the Model 202-C Bolometer Bridge, and to describe recommended adjustment procedures.

b. Return the instrument to Measurements Corporation whenever repairs involving replacement of components is necessary.

SECTION II

CONDENSED THEORY OF OPERATION

27. GENERAL

a. A circuit diagram of the Model 202-C is shown at the rear of the manual.

b. The Model 202-C consists of the following basic circuits.

(1) Power supply.

(2) Temperature controlled oven.

(3) Wheatstone bridge.

(4) Bridge amplifier.

(5) Phase detector.

(6) Null indicator.

28. POWER SUPPLY

a. The power supply is of the conventional type. T3, the power transformer, supplies heater voltages for the various control tubes and high voltage which is rectified by V5, and is filtered to serve as the plate supply for the amplifiers. In addition, rectifier CR1 supplies a negative bias to the thyratron oven heater control tube V4.

29. OVEN

a. The oven temperature is maintained constant by means of oven heater R6, and temperature sensitive resistor RT1, which is part of an a.c. bridge.

30. TEMPERATURE CONTROL AMPLIFIER

a. The error signal from this a.c. bridge is amplified by the temperature control amplifier V3 and then fed to the oven heater control.

31. OVEN HEATER CONTROL

a. The amplified oven error signal is used to control the firing of thyratron V4, the plate current of which is used to heat oven heater R6, raising the oven temperature, and thus reducing the error signal until the thyratron tube V4 no longer conducts. After initial warmup. this heating cycle occurs approximately once per minute.

32. WHEATSTONE BOLOMETER BRIDGE

a. The Wheatstone Bridge consists of four arms: R8 and R9 are the two upper arms; the Bolometer R7, R1 and the R-F source resistance constitute one of the bottom arms; and the combination of R2, R3, R10, R11 and R12 constitute the other bottom arm.

b. The bridge is driven by a regulated a.c. source through transformer T1, and at balance no signal appears at the junction of R8 with R9.

c. The Bolometer R7 consists of a very fine platinum filament in a small, highly-evacuated glass envelope. The resistance of this element is a function of its temperature, which in turn, is increased by the passage of electric current through it. For this reason the Bolometer is contained in the highly-stable temperature controlled oven. At radio frequencies the Bolometer is effectively across the r-f input fitting. The r-f input signal current raises the Bolometer temperature which, in turn, causes an increase in the Bolometer resistance. This increased resistance in one arm of the Wheatstone Bridge unbalances the bridge and a 60-cycle a-c signal appears at the junction of R8 and R9.

d. The Bridge Amplifier and its tube V1 amplifies this bridge error signal and passes it on to the phase detector which compares the phase of the error signal with a reference phase signal, rectifies the amplified error signal and drives the indicator galvanometer M1. Resistor R10 which is directly connected to the main dial is then adjusted to again balance the Wheatstone Bridge for this new Bolometer resistance, and the magnitude of the r-f signal which caused this resistance change is read directly from the calibrated scale.

e. The galvanometer is a simple rugged type of galvanometer and is automatically protected against excessive unbalance voltages by the overload characteristics of the indicating circuit.

SECTION III

PRE-ADJUSTMENT PROCEDURE

33. GENERAL

a. While service in the field is not recommended, if it is absolutely necessary to make such repairs, proceed as follows. However, the accuracy of the instrument may be affected by such temporary repairs.

34. TEST EQUIPMENT REQUIRED

a. The following equipment should be available for adjustment purposes.

b. Multi-meter with a d-c sensitivity of 20,000 ohms-per-volt and a-c sensitivity of 1000 ohms-per-volt.

c. Equipment listed in paragraph 23 for calibration check.

SECTION IV

LOCALIZING THE TROUBLE

35. GENERAL

a. The trouble may be easily located by referring to the Trouble Shooting Chart, Table III, the Tube Voltage Chart, Table IV, and the Schematic Diagram.

SECTION V

REPAIR PROCEDURES

36. REMOVING MODEL 202-C FROM CASE

a. To remove the Model 202-C from case proceed as follows:

(1) Unscrew the two rubber feet located on the bottom front edge of the case, and unscrew the rubber foot located at the bottom rear right edge of the case. Next, remove the sealed screw in the cup washer located in the bottom rear of the case.

(2) Gently tip the top of front panel forward. This permits the line cord to slip through the large hole in the bottom of the case.

(3) The instrument may now be gently slid forward and out of the case.

SECTION VI

ADJUSTMENT PROCEDURES

37. GENERAL

a. When replacing any tubes or making repairs always ascertain that the line plug is removed from the power source.

b. Warning! Never use an ohmmeter in any part of the Wheatstone Bridge circuit involving the Bolometer element located in the temperature controlled oven, as this sensitive element may be permanently damaged by even small currents.

38. TUBE REPLACEMENT

a. If necessary to replace tube V1 or tube V2 proceed as follows.

b. When replacing tube V2, remove tube V1 from its socket. Replace V2 and apply power to the instrument.

c. Allow a minute or so for instrument to stabilize and adjust BAL. control located on chassis between the 12AU7 and 12AX7 tubes, until the meter pointer is exactly over the reference line at center scale. Replace tube V1 and check operation as described in Chapter 2, Section III, paragraphs 19 through 22.

d. When replacing tube V1 proceed as in paragraph 38 'b' and 'c' above. Then ground pin number 1 of V1 (12AX7) and check meter indicator. If the meter pointer is not within 1/8 inch of the reference line, V1 is generating excessive hum and should be replaced by one which allows the meter pointer to center.

e. Tube V3, V4 and V5 may be replaced with no special precautions. However, it is well to review Chapter 2, Section III regarding oven cycle time before proceeding.

APPENDIX I

STORAGE AND SHIPMENT

1. STORAGE

a. Remove dust from controls and outer surface of instrument with a clean rag.

b. Wrap instrument in heavy wrapping paper and seal seams with gummed tape or similar adhesive.

d. Store in a dry place. If excessive humidity is unavoidable place the wrapped instrument in a moisture-proof bag with a sufficient quantity of drying agent, such as silica gel, to insure a dry atmosphere.

(1) When the use of bag and desiccant is necessary, check the instrument at 6 month intervals to determine the effectiveness of the seal.

2. SHIPMENT

a. Wrap the instrument with heavy wrapping paper and seal seams with gummed tape or similar adhesive.

b. Place in fibre-board carton or wooden box large enough to permit at least 3 inches of excelsior or similar packing material between the instrument and sides of the box.

(1) For export packing wrap the instrument in waterproof paper and seal the seams with glue or similar sealing compound before placing the instrument in a wooden box.

APPENDIX.II.

TABLE OF REPLACEABLE PARTS

Model 202-C Standard Bolometer Bridge

Symbol	Meas. Corp. Part Number	Description
Capacitors		
C1	H-4233	Ceramic, .01 mfd., minimum
C2	H-5002	Electro, 8 mfd, 450 V.
C3	H-5131	Mica,.01 mfd., ± 20%, 300 V.
C4	H-5596	Paper, .25 mfd., ± 20%, 600 V.
C5	H-5182	Electro, 25 mfd., 25 V.
C6	H-5131	Mica, .01 mfd., ± 20%, 300 V.
C7	H-5589	Paper, .1 mfd., ± 20%, 400 V.
C8 C9 C10	H-5061	Electro, 10-10-10 mfd., 450 V.
C11	H-5182	Electro, 25 mfd., 25 V.
C12	H-5065	Ceramic, .01 mfd.
C13		Not Used.
C14	H-5569	Ceramic, 1000 mmf.
C15	H-5569	Ceramic, 1000 mmf.
Lamps		
E1	H-6326	Neon
E2	H-5016	6 V.
E3	H-5588	12v.
Crystal		
CR1		#1N34-A
Fuse		
F1	H-5018-6	1/2 amp.

Symbol	Meas. Corp. Part Number	Description
Connector		
J1	H-4828	Panel Jack, type N.
Choke		
L1	H-5570	Choke, 1 microhenry.
L2	H-5570	Choke, 1 microhenry.
Meter		
M1	H-964	Indicator
Plug		
P1		Part of W1.
Resistors		
R1	*H-4237	Metal film, 60 ohms.
R2	*H-5915-1	W.W., approx. 500 ohms.
R3	*H-5915-1	W.W., approx. 500 ohms.
R4	H-5915-2	W.W., approx. 250 ohms.
R5		Part of pilot light assembly.
R6		Part of oven assembly.
R7	*H-4223	Bolometer.
R8	H-5571	W.W., 350 ohms, ± 1%, 0.5 W.
R9	H-5571	W.W., 350 ohms, ± 1%, 0.5 W.
R10	H-5574	Var., W.W., 100 ohms.
R11 R12	H-3865	Var., W.W., dual 75 ohms and 15 ohms.
R13	H-3728-473	Comp., 47,000 ohms ± 10%, 1/2 W.
R14	H-3728-105	Comp., 1 megohm, ± 10%, 1/2 W.
R15	H-3728-224	Comp., 220,000 ohms, ± 10%, 1/2 W.

* Replacement of these resistors is not recommended in the field.

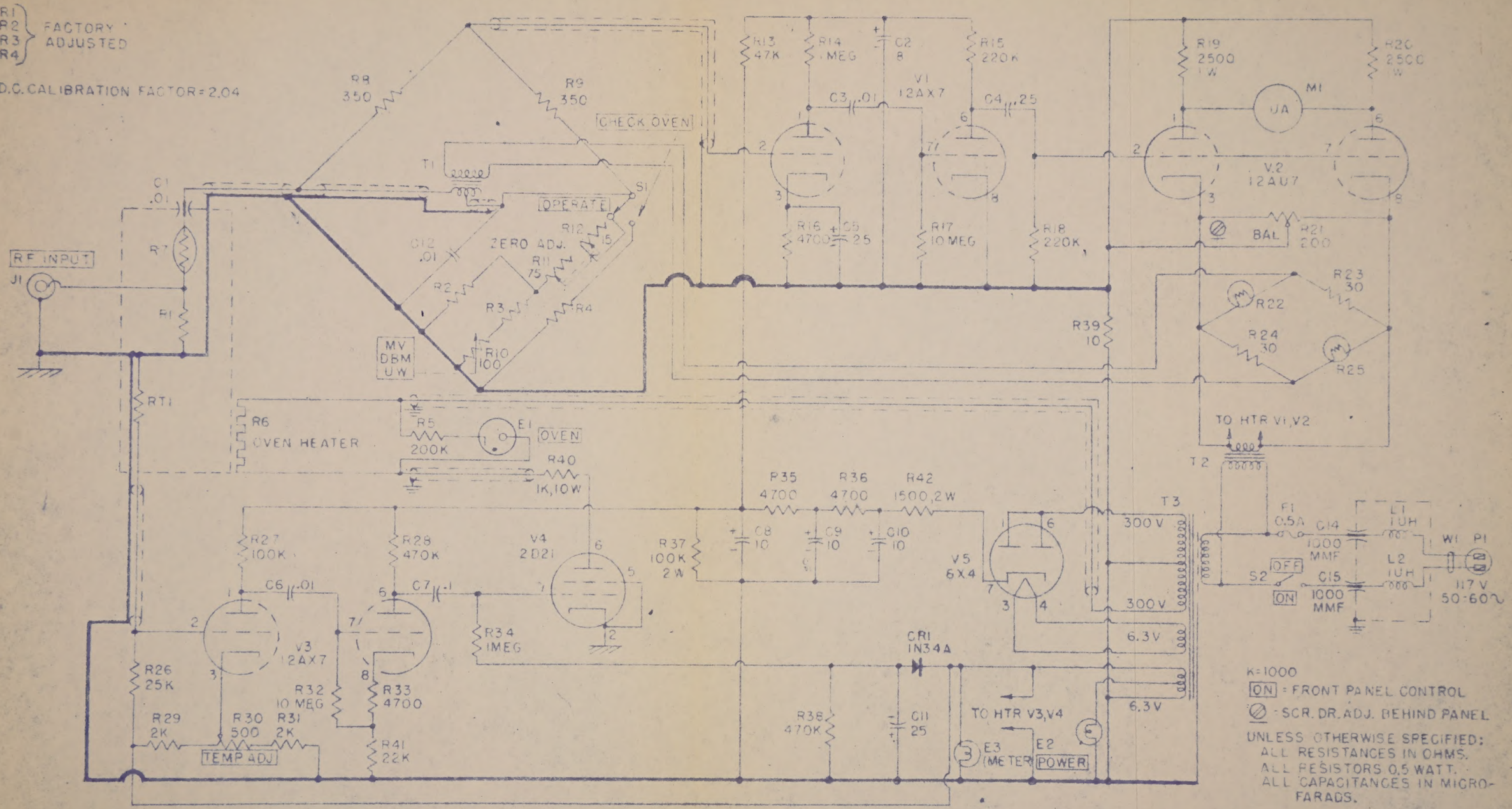
Symbol	Meas. Corp. Part Number	Description
Resistors - Cont.		
R16	H-3728-472	Comp., 4,700 ohms, ± 10%, 1/2 W.
R17	H-3728-106	Comp., 10 megohms, ± 10%, 1/2 W.
R18	H-3728-224	Comp., 220,000 ohms, ± 10%, 1/2 W.
R19	H-3745-3	Metal film, 2,500 ohms, ± 2%, 1 W.
R20	H-3745-3	Metal film, 2,500 ohms, ± 2%, 1 W.
R21	H-5521-1	Var., W.W., 200 ohms, ± 10%, 4 W.
R22	H-5016	Lamp
R23	H-2196-1	W.W., 30 ohms, ± 1%.
R24	H-2196-1	W.W., 30 ohms, ± 1%.
R25	H-5016	Lamp
R26	H-5573	W.W., 25,000 ohms, ± 1%, 0.5 W.
R27	H-3728-104	Comp., 100,000 ohms, ± 10%, 1/2 W.
R28	H-3728-474	Comp., 470,000 ohms, ± 10%, 1/2 W.
R29	H-5572	W.W., 2,000 ohms, ± 1%, 0.5 W.
R30	H-5521-2	Var., W.W., 500 ohms, ± 10%, 4 W.
R31	H-5572	W.W., 2,000 ohms, ± 1%, 0.5 W.
R32	H-3728-106	Comp., 10 megohm, ± 10%, 1/2 W.
R33	H-3728-472	Comp., 4,700 ohms, ± 10%, 1/2 W.
R34	H-3728-105	Comp., 1 megohm, ± 10%, 1/2 W.
R35	H-3728-472	Comp., 4,700 ohms, ± 10%, 1/2 W.
R36	H-3728-472	Comp., 4,700 ohms, ± 10%, 1/2 W.
R37	H-3734-104	Comp., 100,000 ohms, ± 10%, 2 W.
R38	H-3728-474	Comp., 470,000 ohms, ± 10%, 1/2 W.
R39	H-3728-100	Comp., 10 ohms, ± 10%, 1/2 W.

Symbol	Meas. Corp. Part Number	Description
Resistors - Cont.		
R40	H-5118	W.W., 1,000 ohms, ± 10%, 10 W.
R41	H-3728-223	Comp., 22,000 ohms, ± 10%, 1/2 W.
R42	H-3734-152	Comp., 1500 ohms, ± 10%, 2 W.
Thermistor		
RT1	H-4240	44,000 ohms, ± 10% at 25° C.
Switches		
S1	H-383-8	Switch, Toggle, DPDT.
S2	H-383-5	Switch, Toggle, SPST.
Transformers		
T1	H-5575	Filament, 6.3 v., center tapped.
T2	H-5575	Filament, 6.3 v., center tapped.
T3	H-5405	Power.
Tubes		
V1		Electron, RETMA #12AX7
V2		Electron, RETMA #12AU7
V3		Electron, RETMA #12AX7

Symbol	Meas. Corp. Part Number	Description
Tubes - Cont.		
V4		Electron, RETMA #2D21.
V5		Electron, RETMA #6X4.
Cord		
W1	H-704	Power, includes P1.

R1
R2
R3
R4
} FACTORY ADJUSTED

D.C. CALIBRATION FACTOR = 2.04



K = 1000

ON = FRONT PANEL CONTROL

⊘ - SCR. DR. ADJ. BEHIND PANEL

UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCES IN OHMS.
ALL RESISTORS 0.5 WATT.
ALL CAPACITANCES IN MICROFARADS.

SCHEMATIC DIAGRAM
MODEL 202-C

B-5901-E

MEASUREMENTS

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